

# **Proposed test cases based on satellite images**

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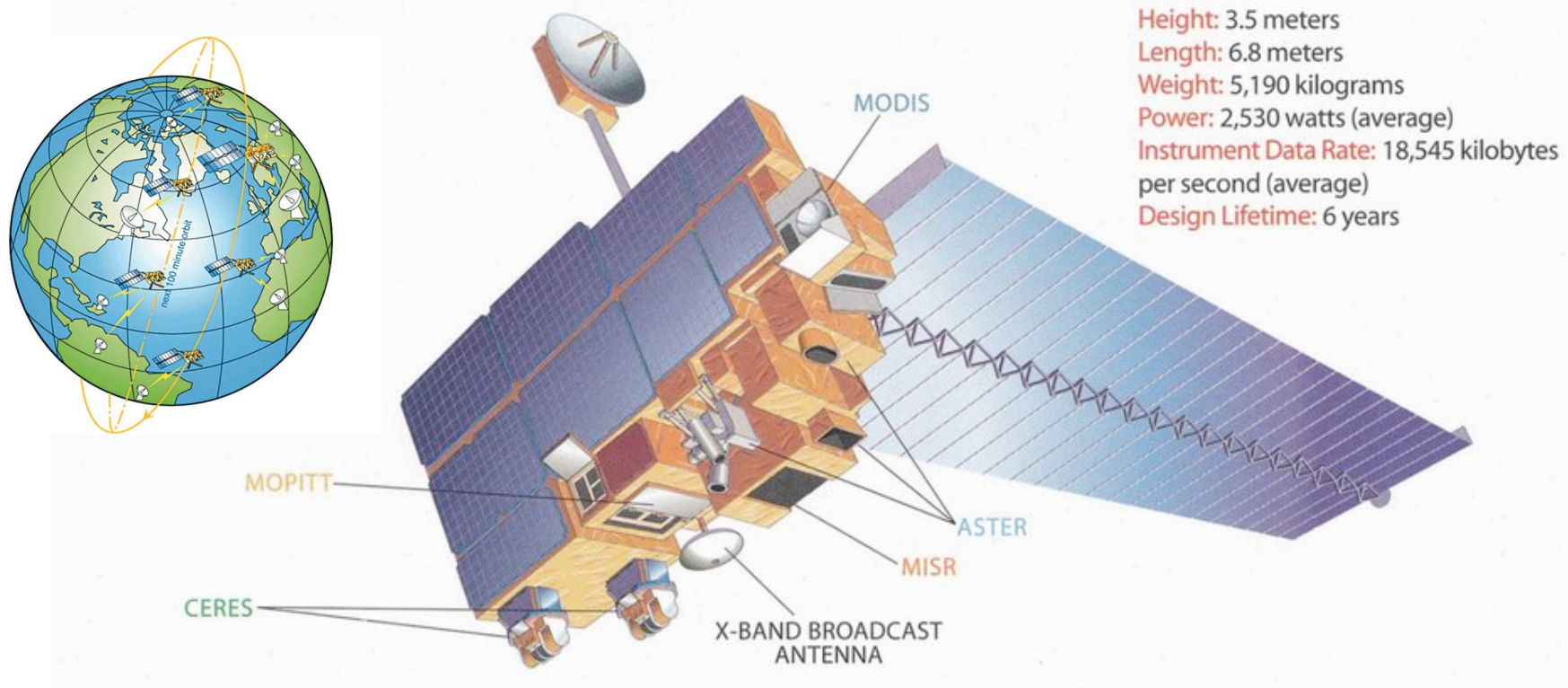
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**<sup>a</sup>University of Maryland, Baltimore County**

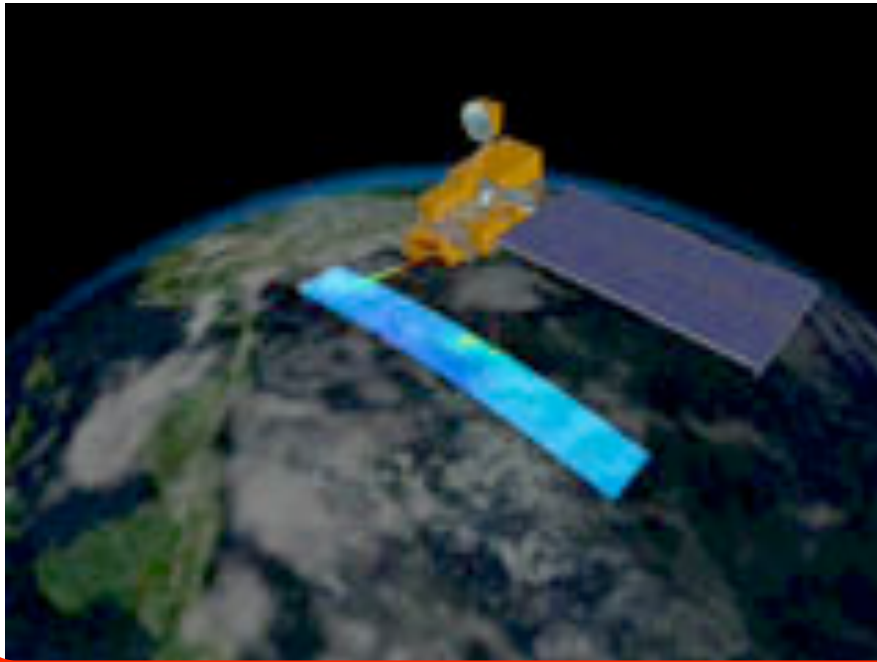
**<sup>b</sup>NASA Goddard Space Flight Center**

# Use MODIS, MISR, ASTER, CERES Observations

## Terra and Its Five Climate-Monitoring Sensors



705 km, 10:30 AM local time, descending node, Sun-synchronous, near polar

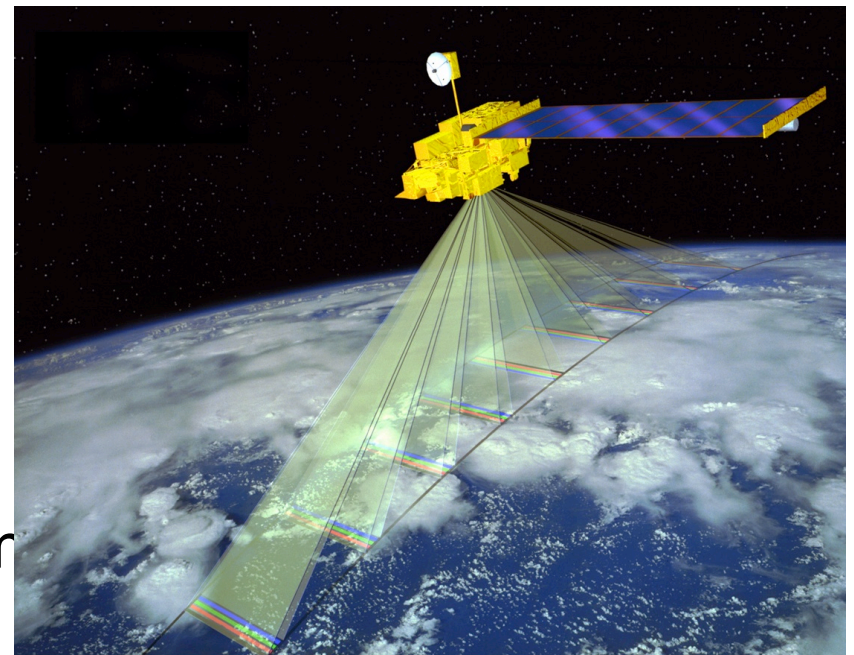


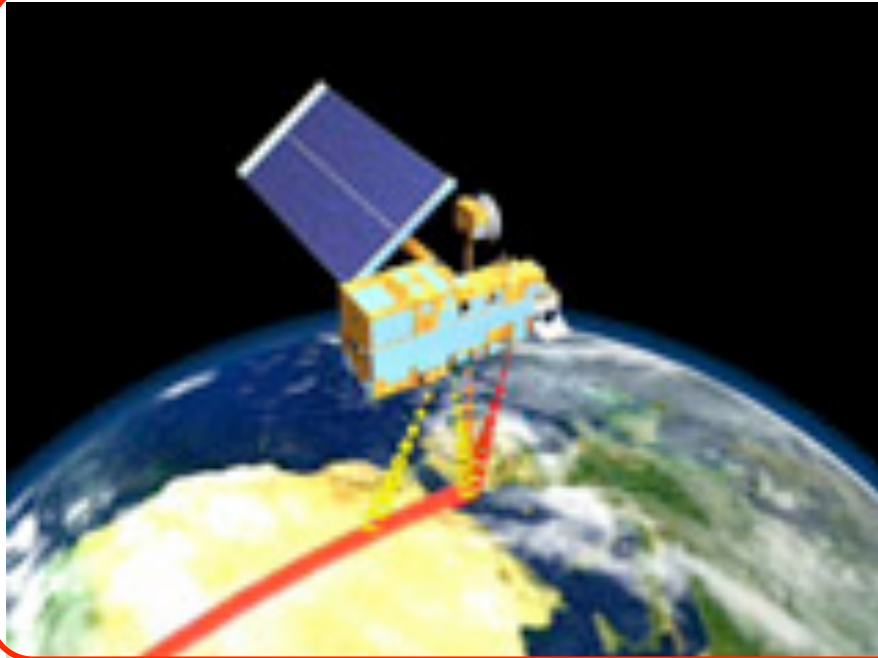
## MODIS

- 36 bands from 0.4 to 14.4 $\mu$ m
- Resolution: 250m(band 1-2)  
(at nadir) 500m(band 3-7)  
1km(bands 8-36)
- Swath: 2330 km

## MISR

- 9 cameras (4 bands, VIS, NIR)  
1 nadir viewing  
others: forward and afterward  
view angles of  
26.1, 45.6, 60., 70.5 degrees
- Resolution 270m, 550m or 1.1km
- Swath: 360 km



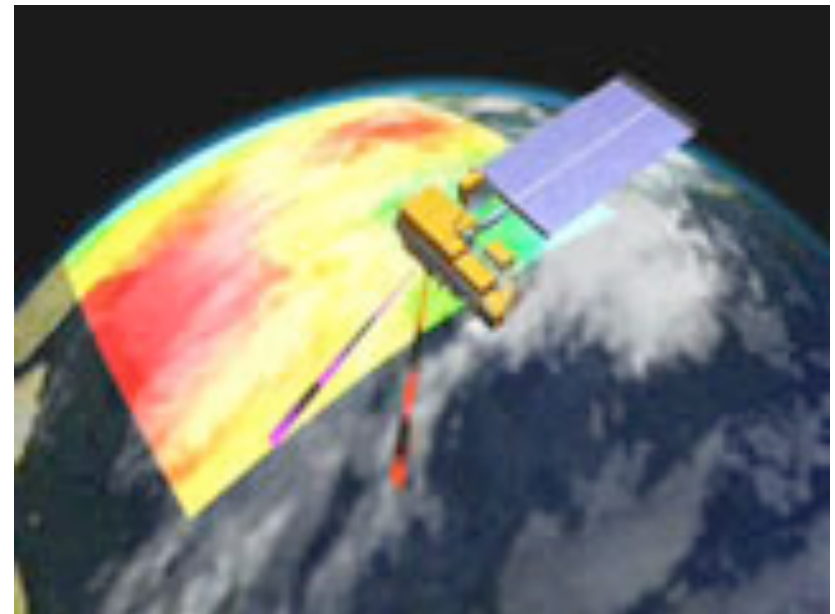


## ASTER

- 14 bands, 0.5~11 microns
- High resolution
  - 15m : VNIR (0.5-0.86 $\mu$ m)
  - 30m : SWIR (1.6-2.4 $\mu$ m)
  - 90m : TIR (8.2-11.7 $\mu$ m)
- Swath : 60km

## CERES

- 3 broadbands:
  - SW: 0.3-5.0 microns
  - Window: 8-12 microns
  - Total: 0.3 - > 200 microns
- Resolution: 20km at nadir
- Swath: Limb to limb
- Biaxial scan mode





# Properties of Phase 3 Case

## Observations

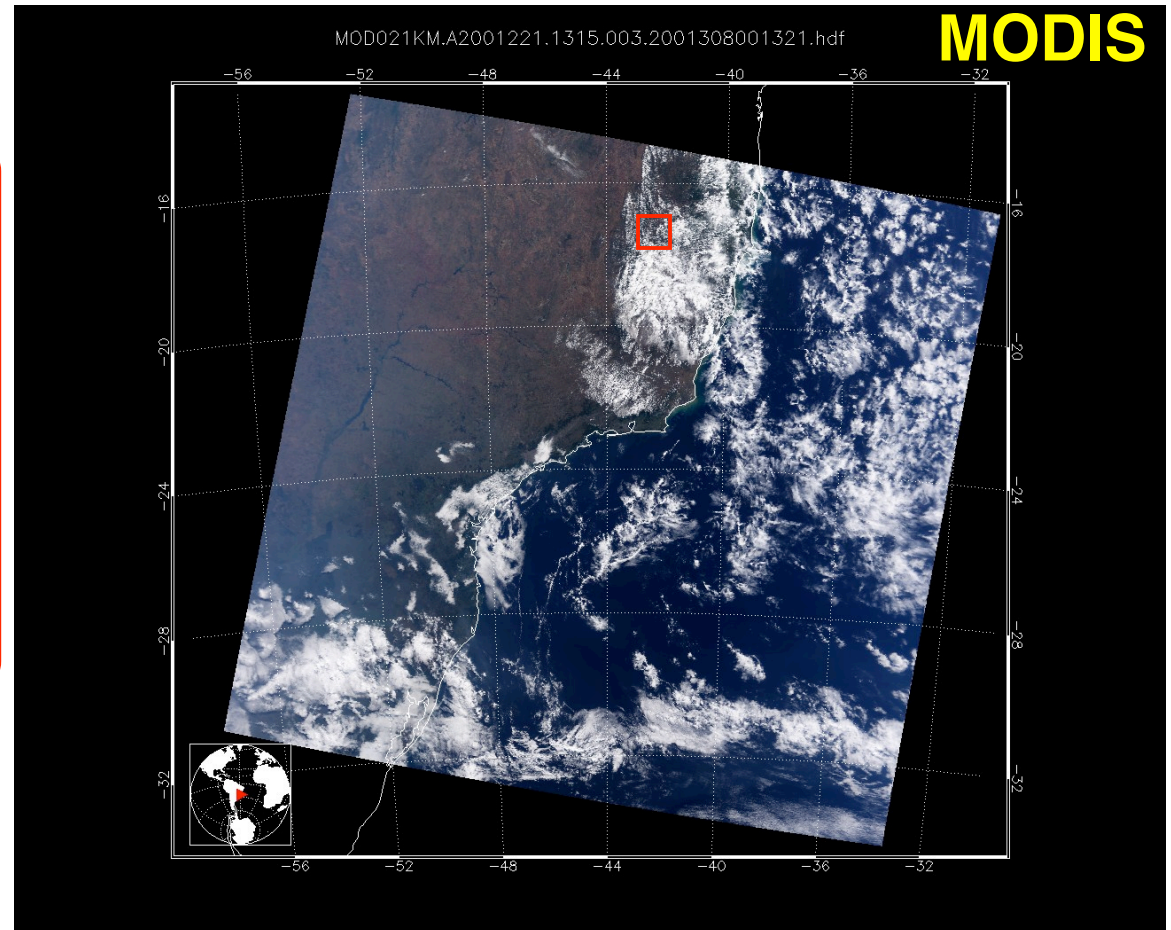
- ✓ MODIS VIS and NIR nadir reflectance
- ✓ MISR angular variation of radiance
- ✓ ASTER high resolution
- ✓ CERES broadband TOA SW, LW fluxes

## Products

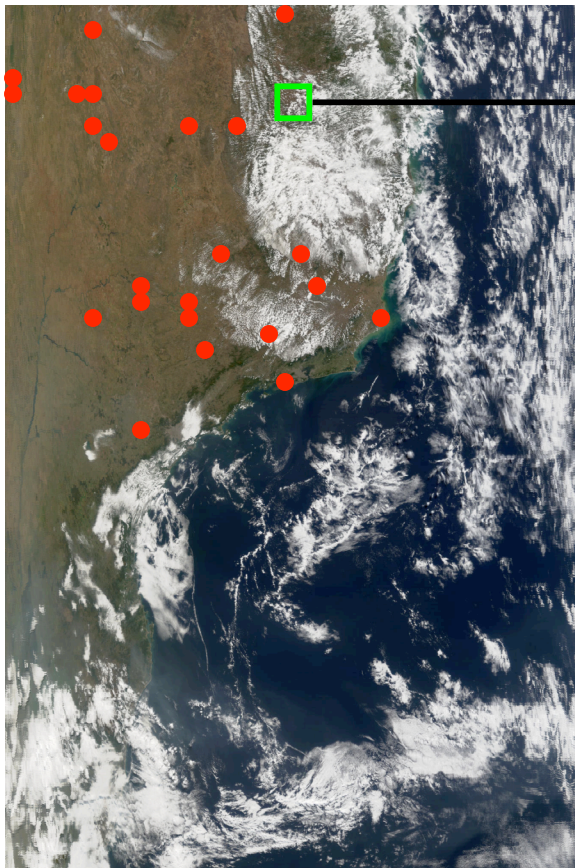
- ✓ cloud phase, optical depth, effective radius
- ✓ cloud top height (derived)
- ✓ aerosol optical thickness model
- ✓ surface albedo and BRDF
- ✓ temperature

# Proposed Case

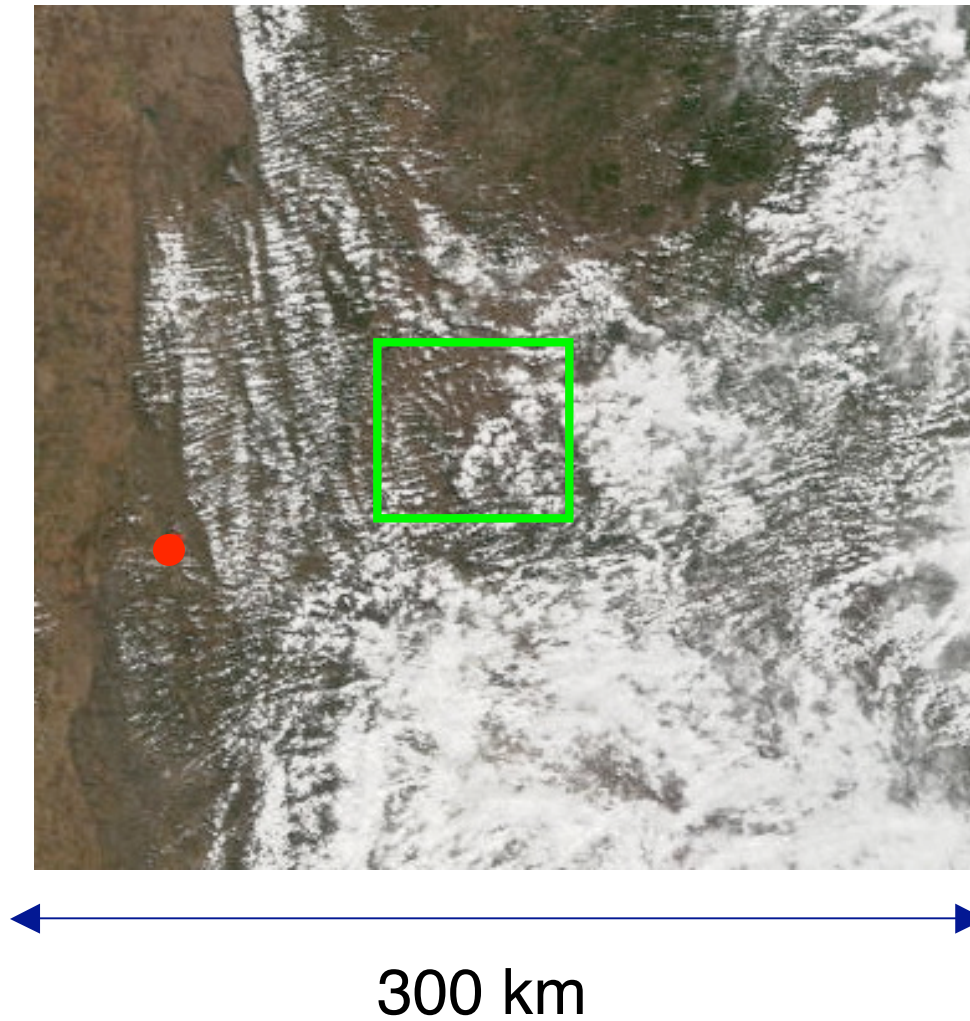
A sub-image of 68 x 80 of  
1km MODIS in Brazil  
centered at  $(-17.10^\circ, -42.16^\circ)$   
acquired at 13:15 UTC  
(10:15AM local)  
August 9, 2001  
SZA:  $41^\circ$   
SAM:  $38^\circ$



# Why Brazil?



# A sub-image from MODIS





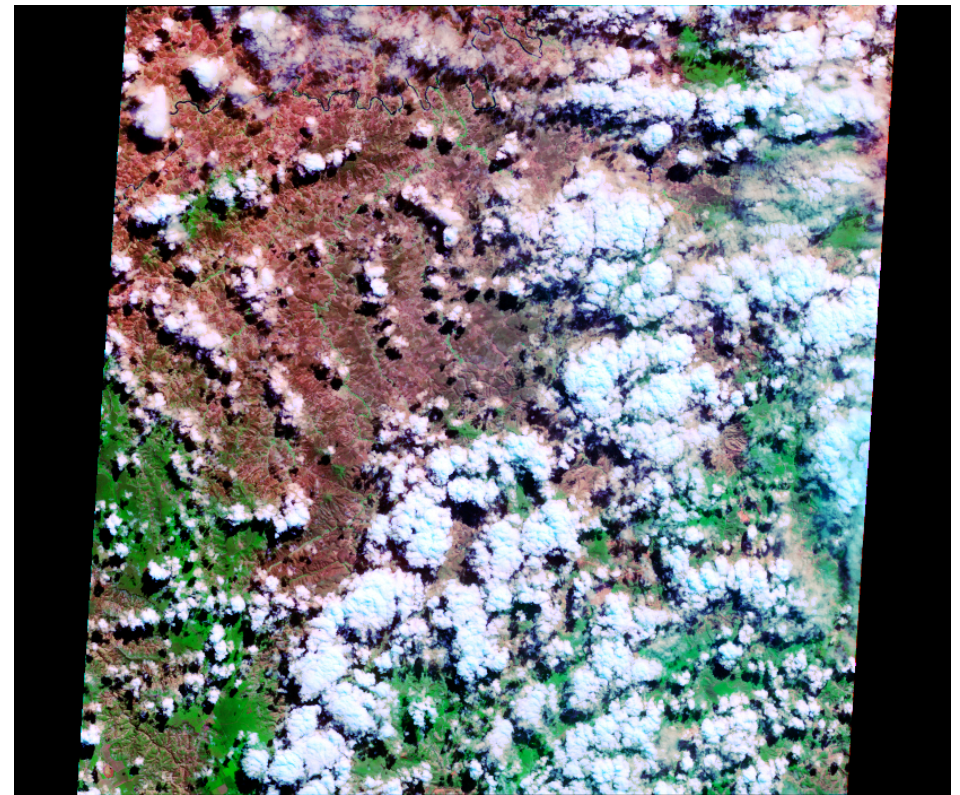
# Complex Both in Cloud Field and Surface Properties

## MODIS Image (1km)



← 60 km →  
RGB  
(2.1, 0.8, 0.55)

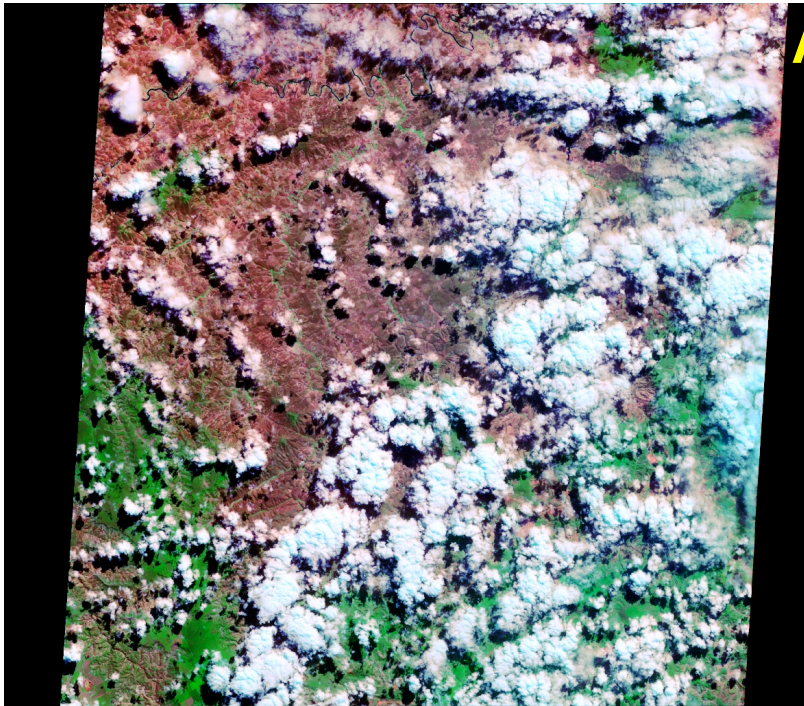
## ASTER Image (30m)



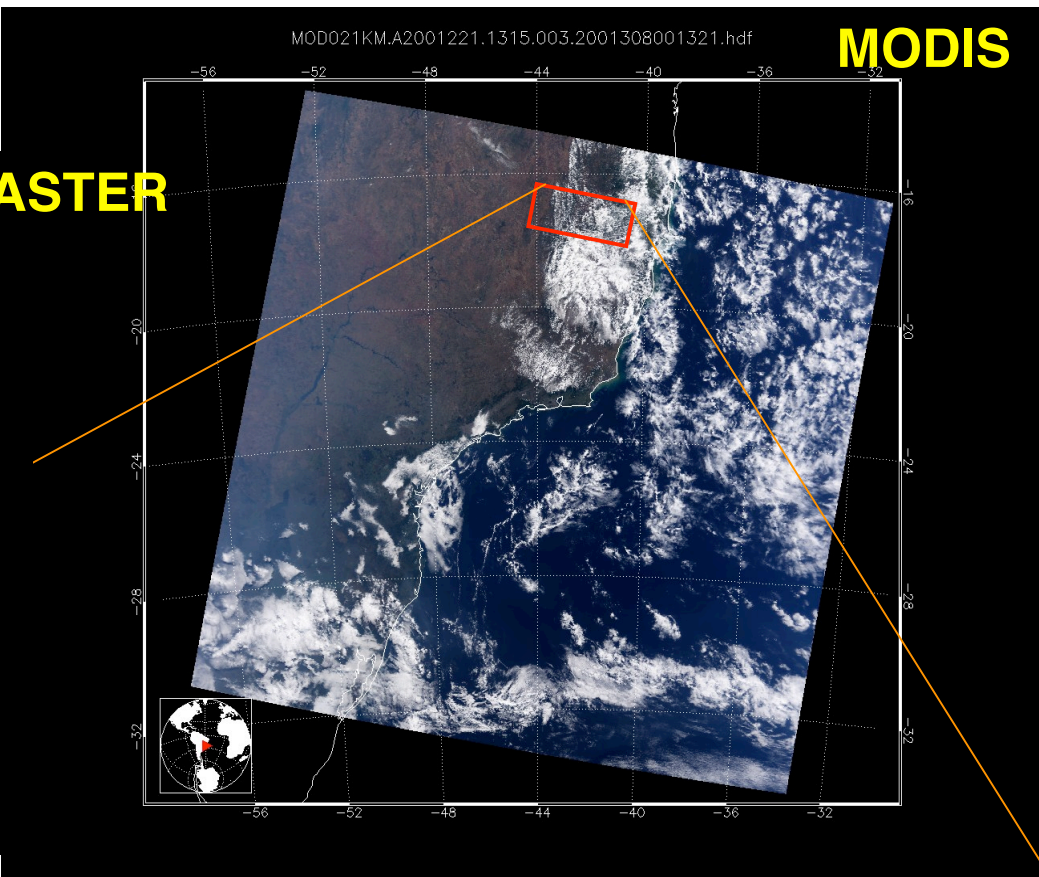
← 60 km →  
RGB  
(2.1, 0.8, 0.55)



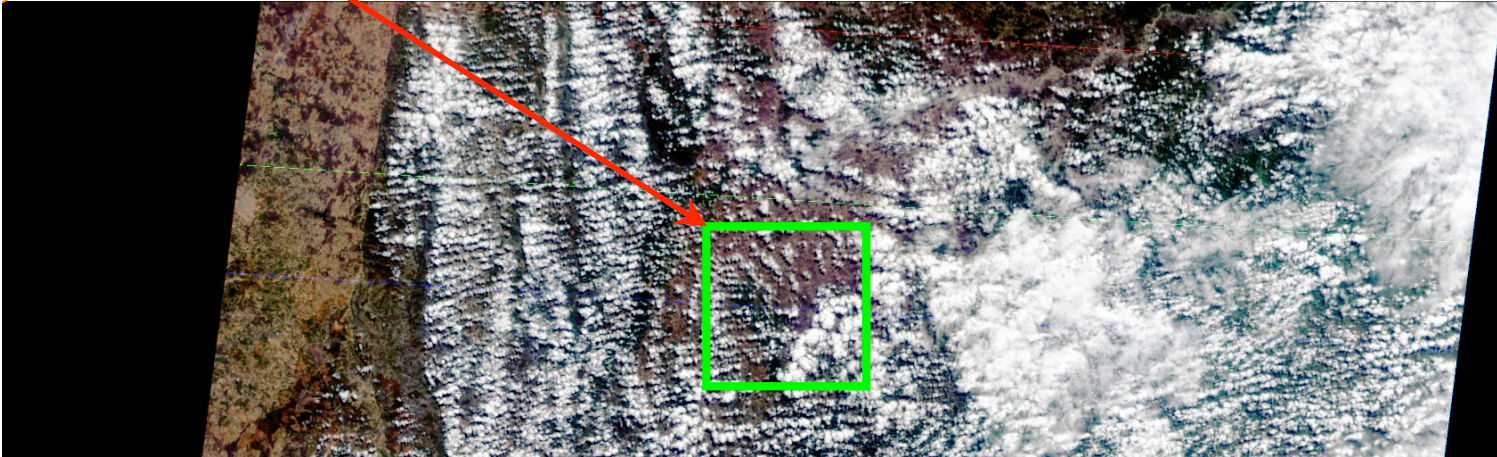
# Overview Images



**ASTER**

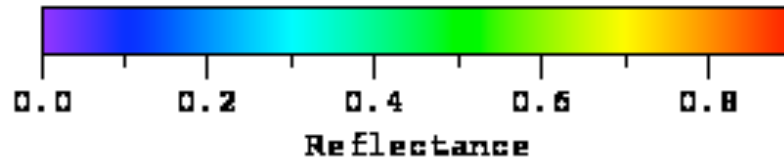
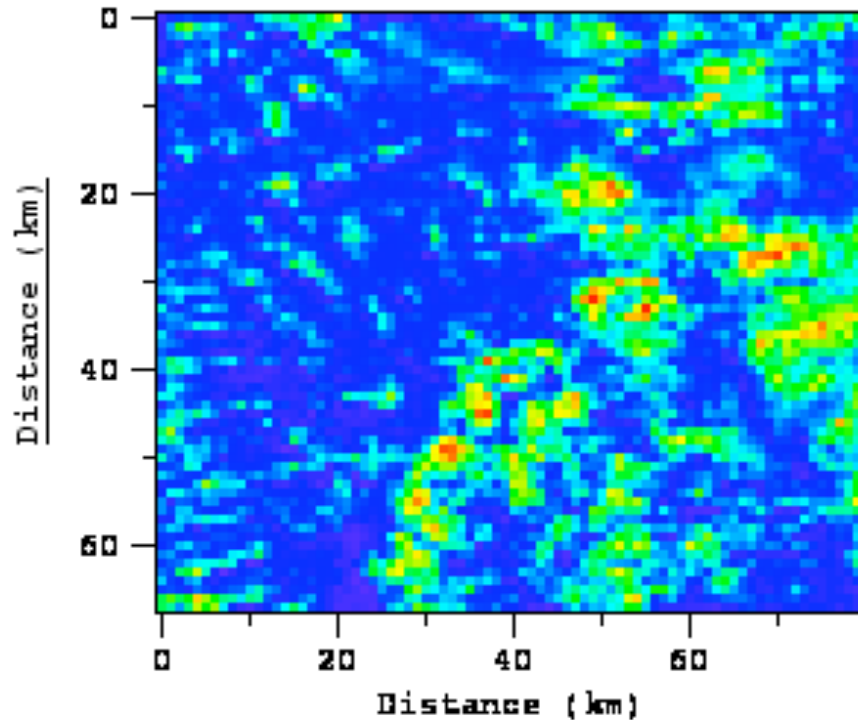


**MISR**

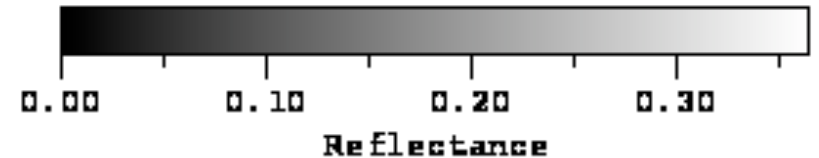
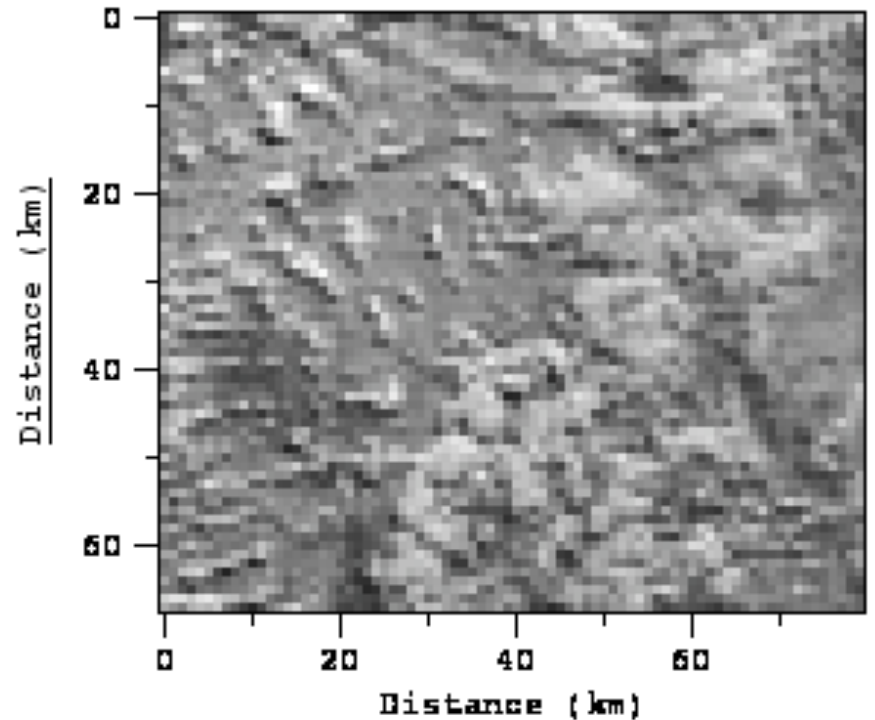


# MODIS Nadir Reflectance

0.67 microns

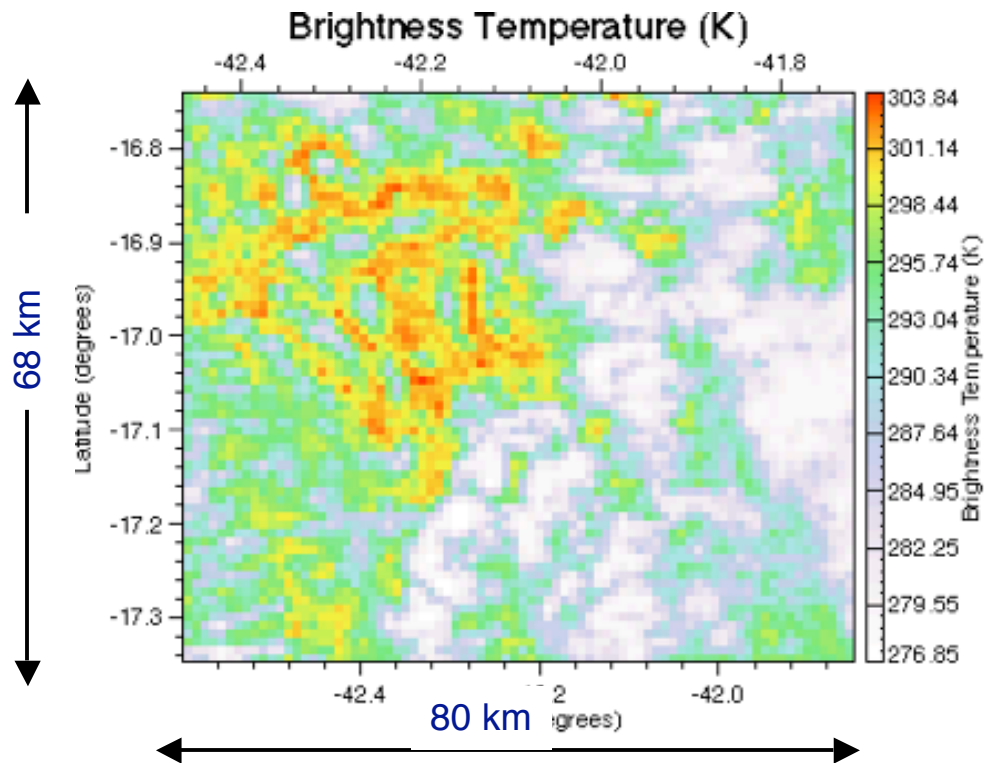


2.13 microns





# MODIS Brightness Temperature

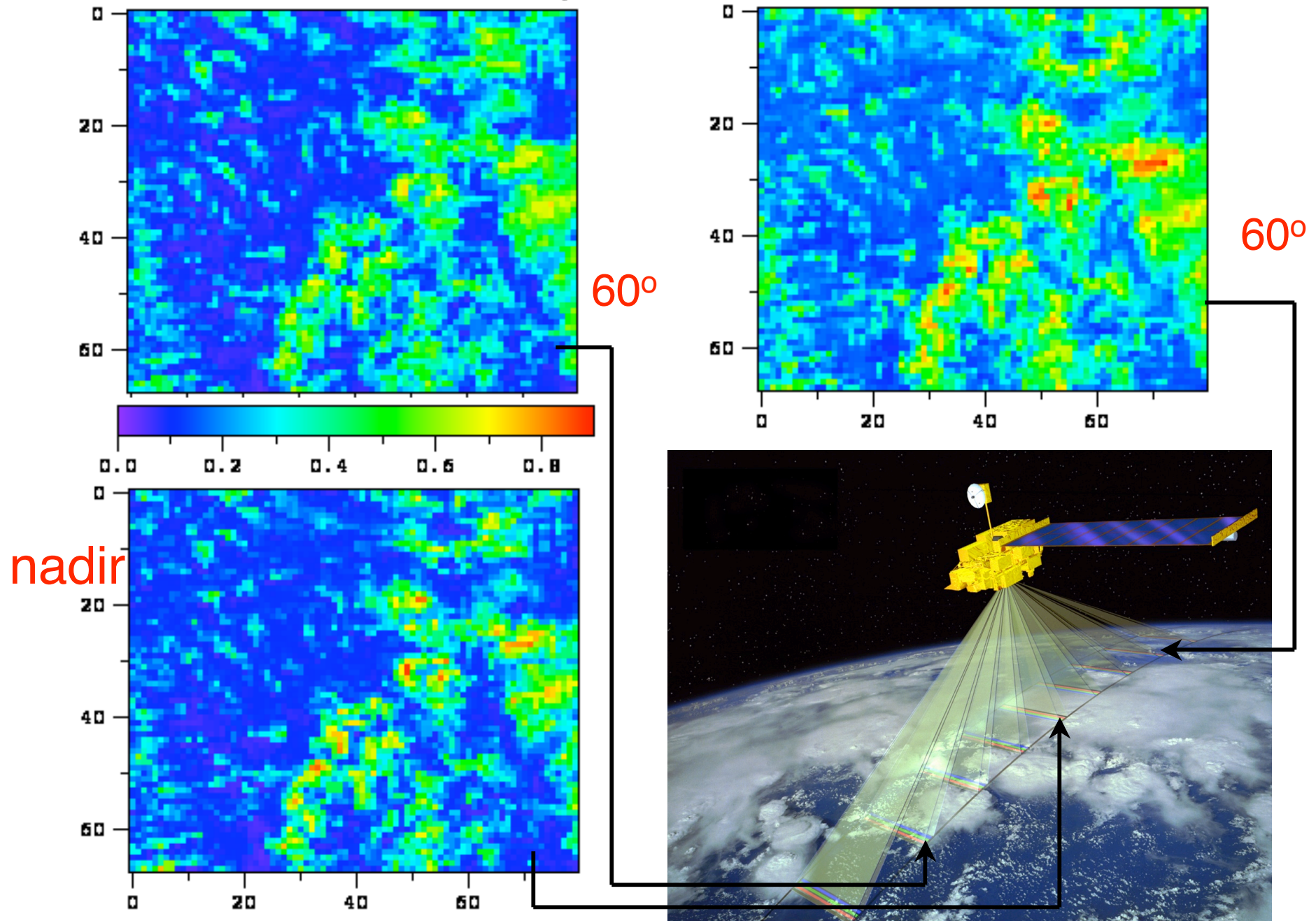


ASTER Image

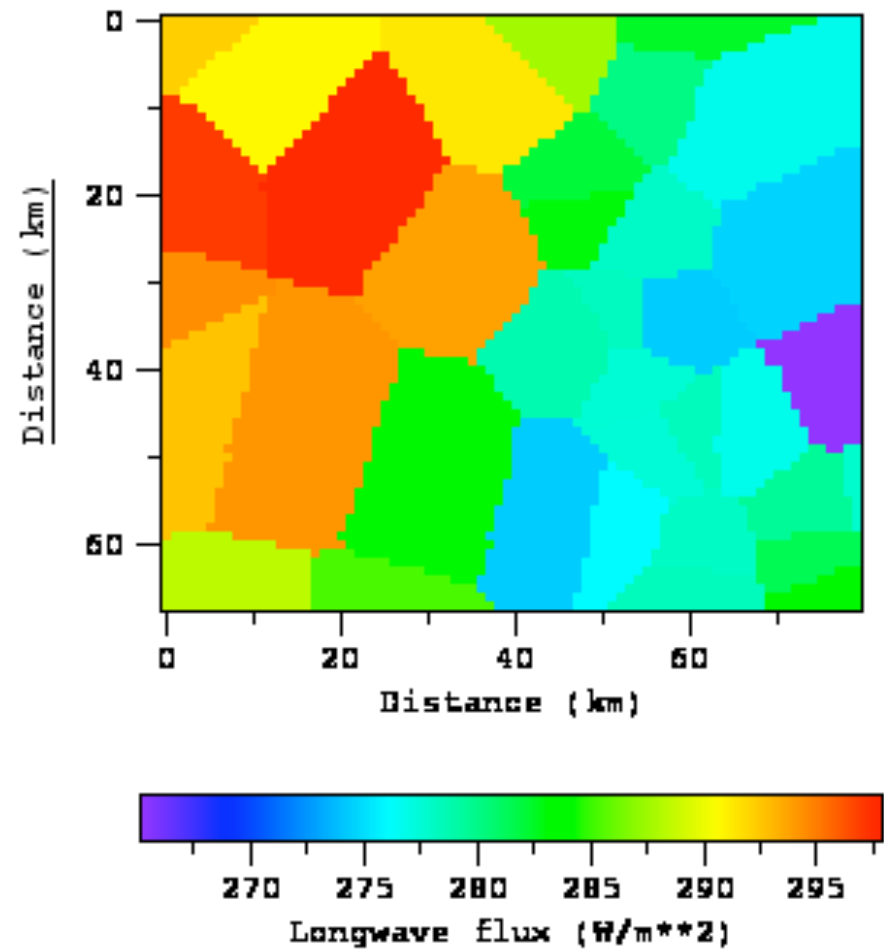
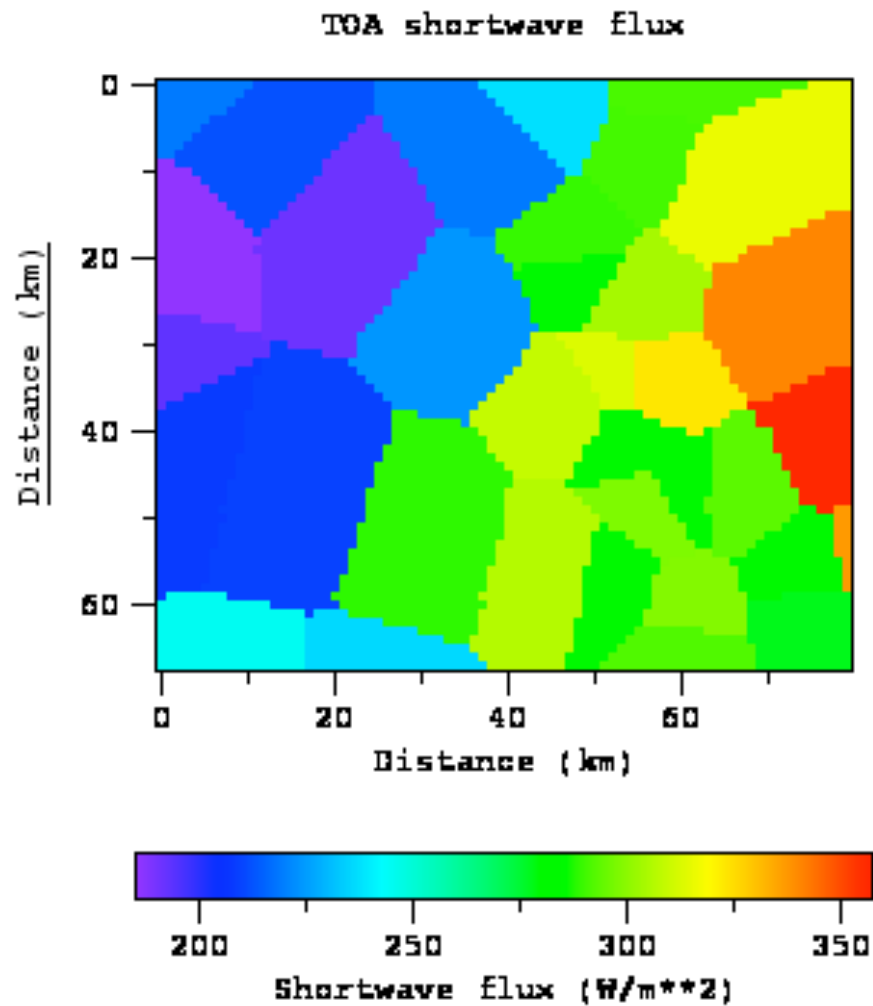




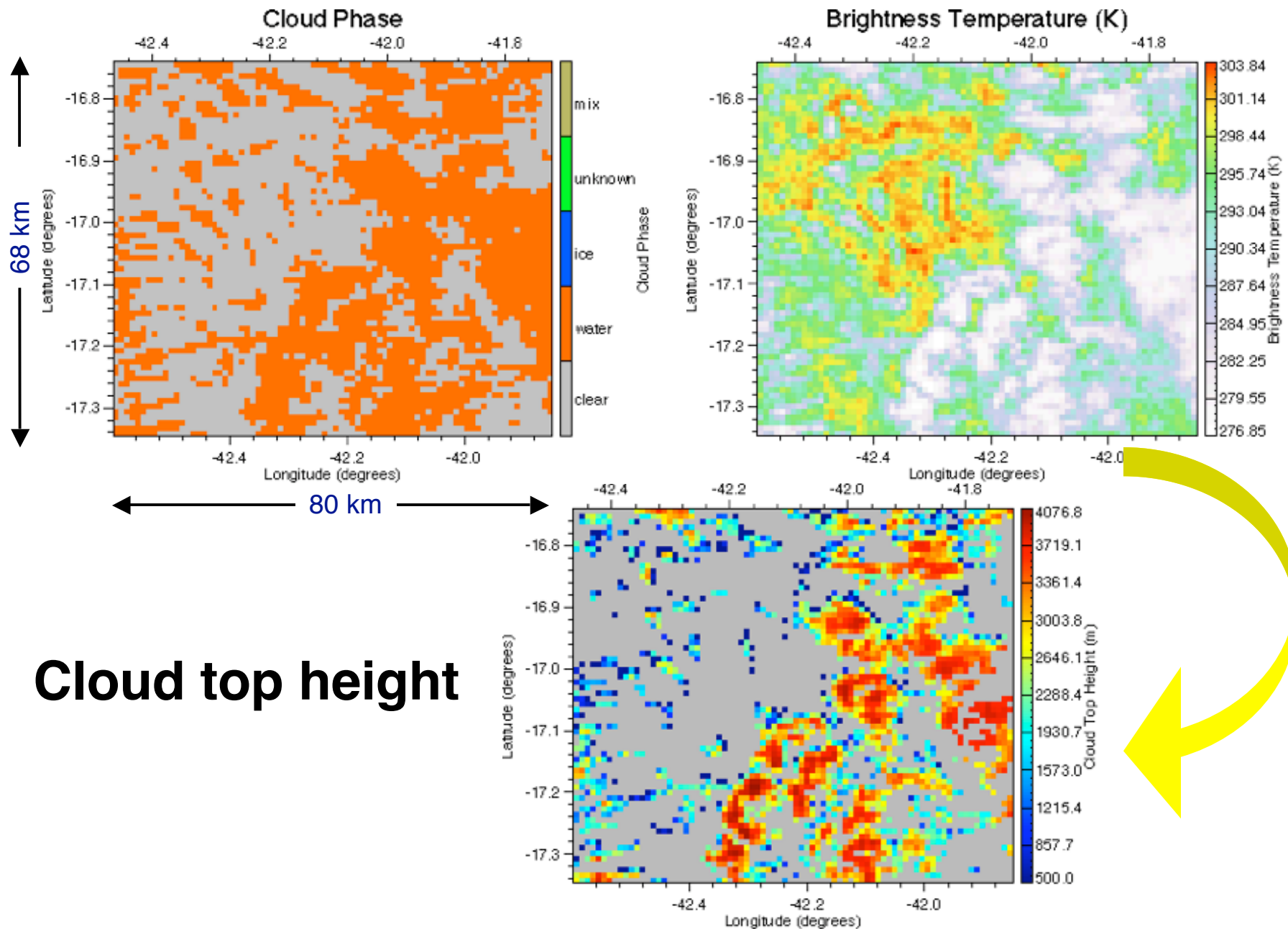
# MISR Images at 0.67microns



# CERES SW and LW Fluxes

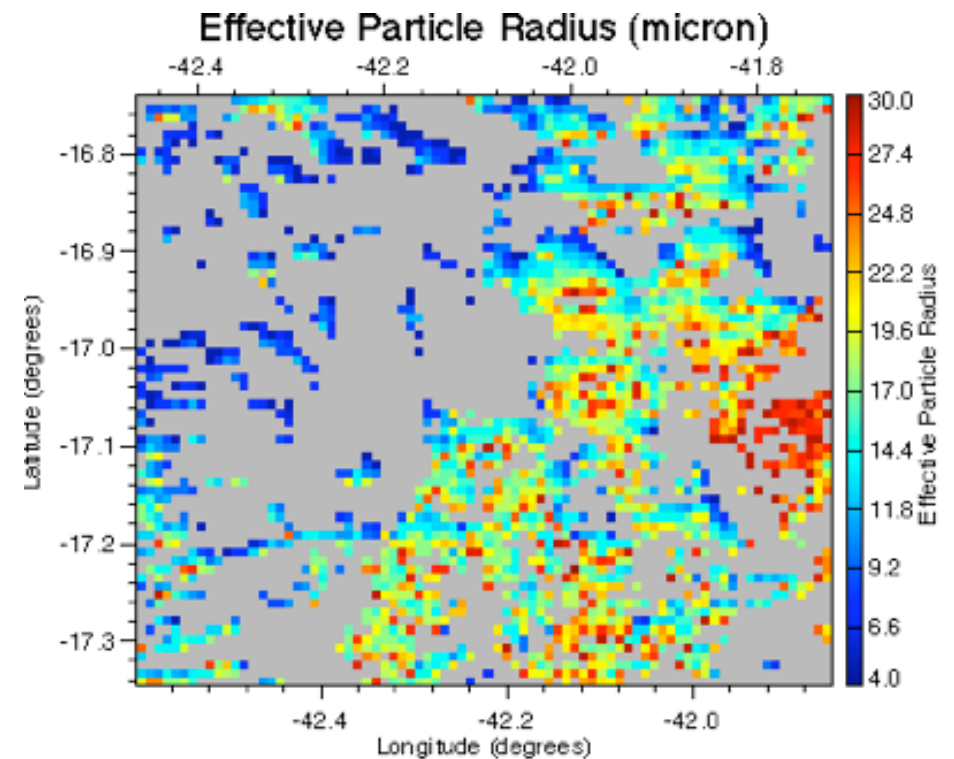
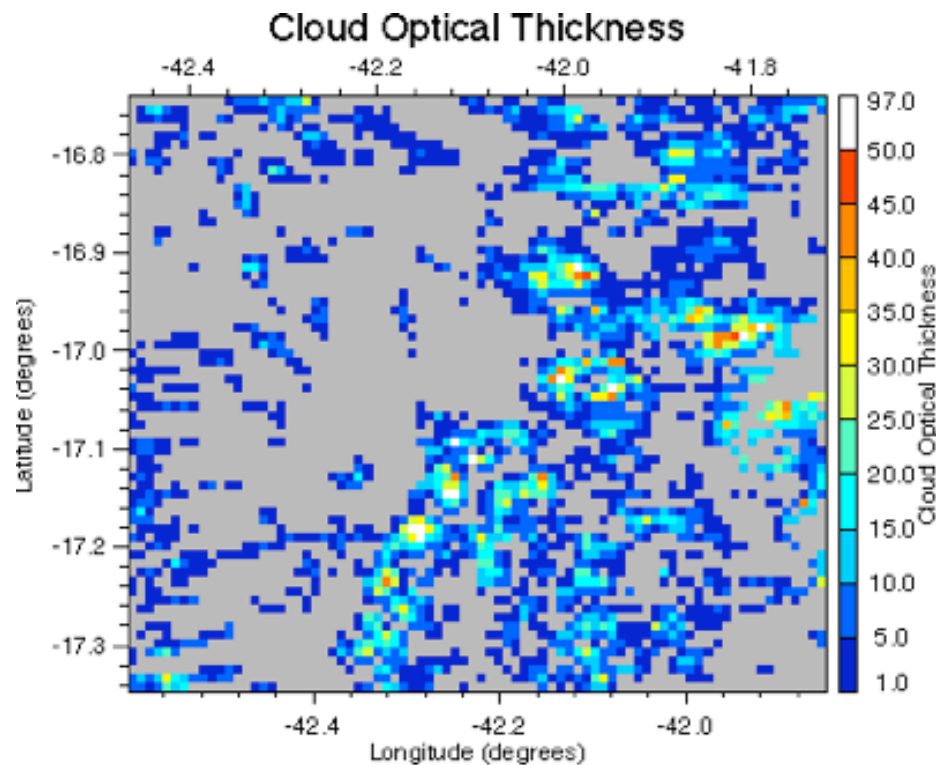


# MODIS Cloud Products



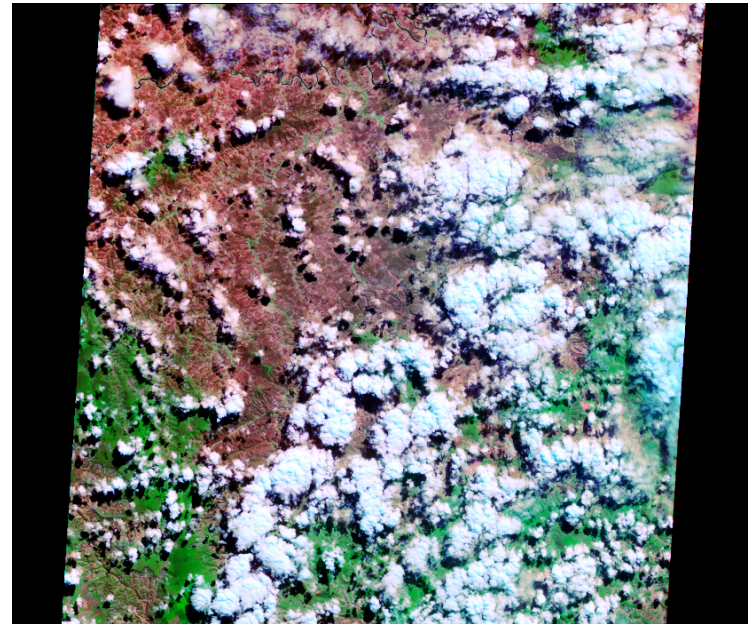
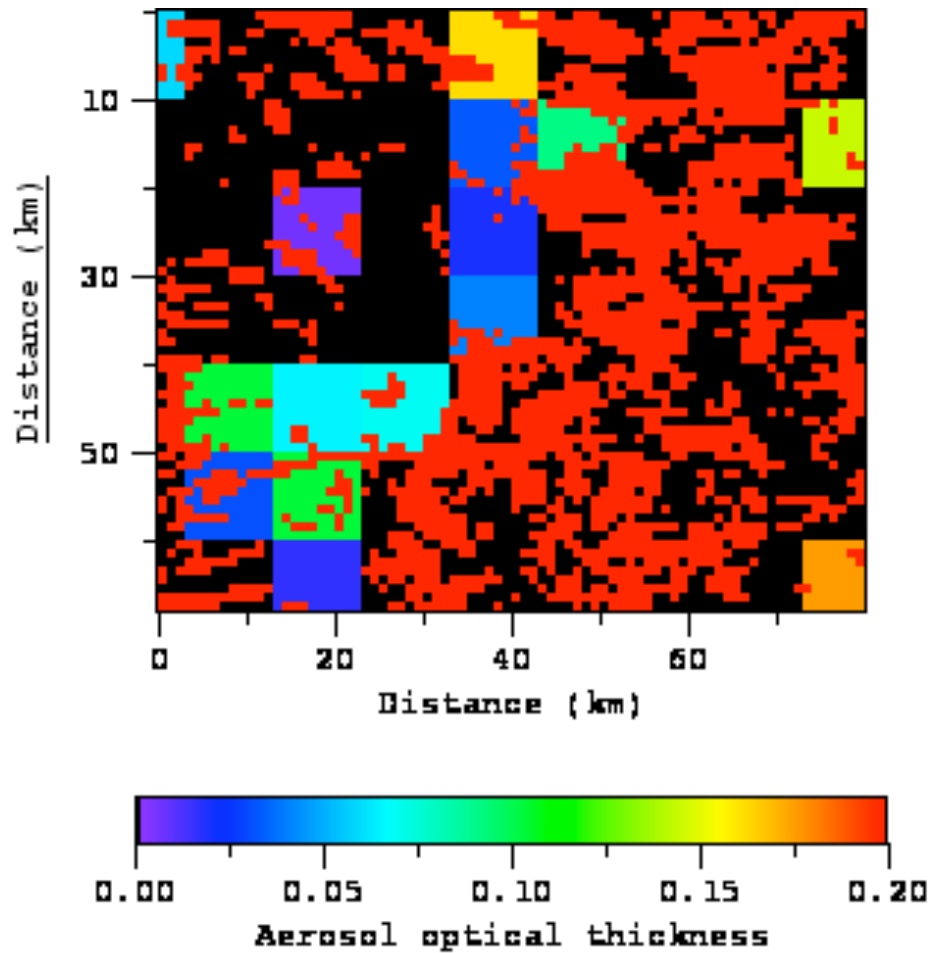
**Cloud top height**

# MODIS Cloud Products (cont.)

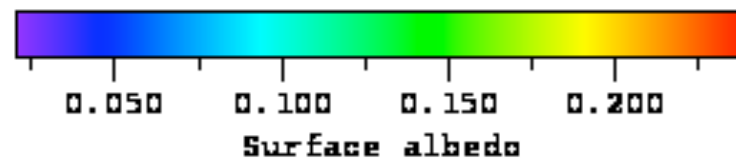
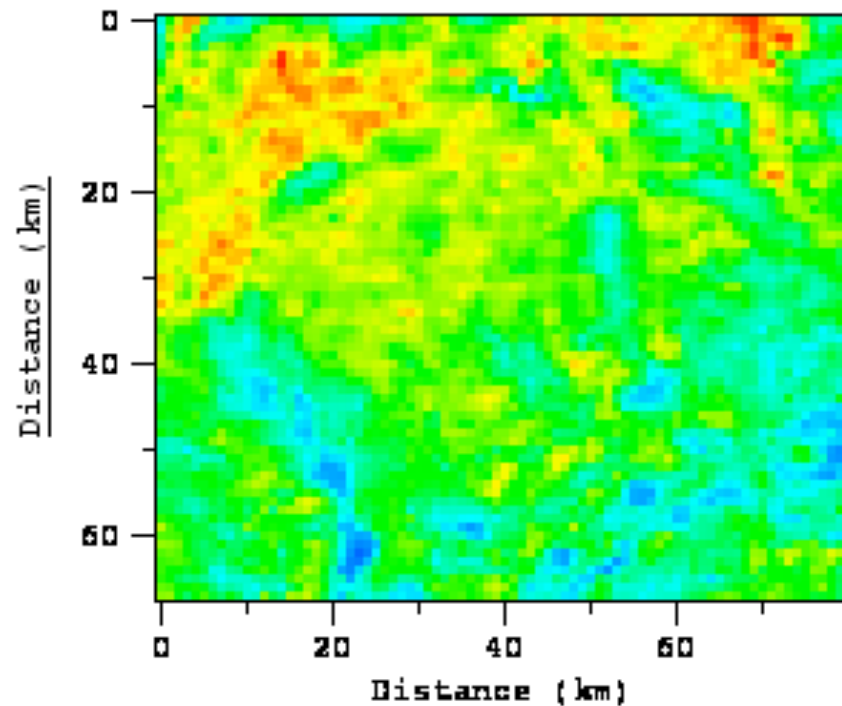
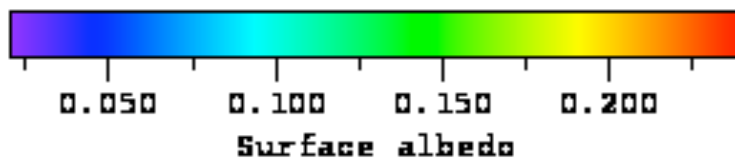
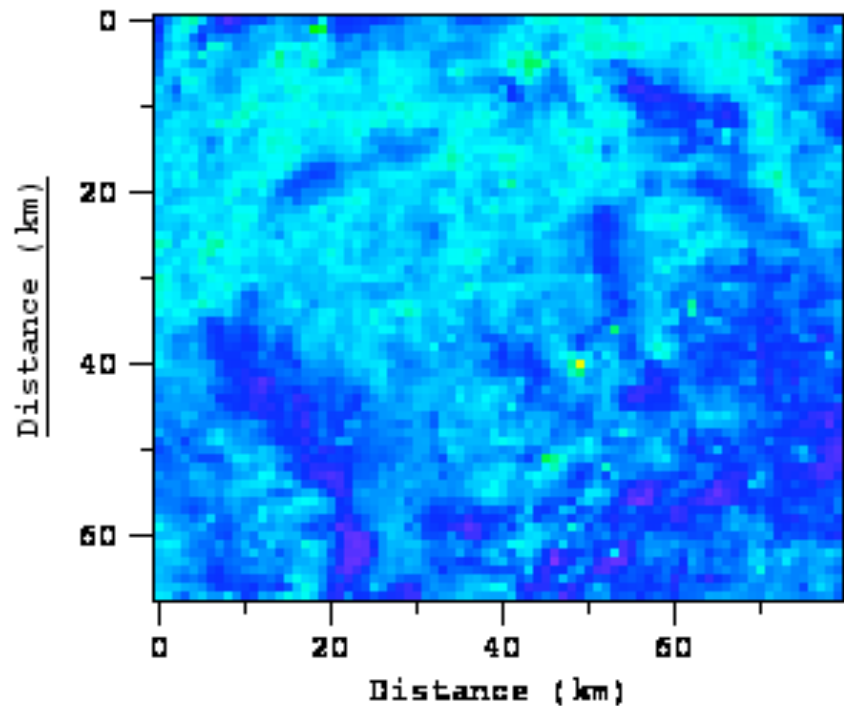




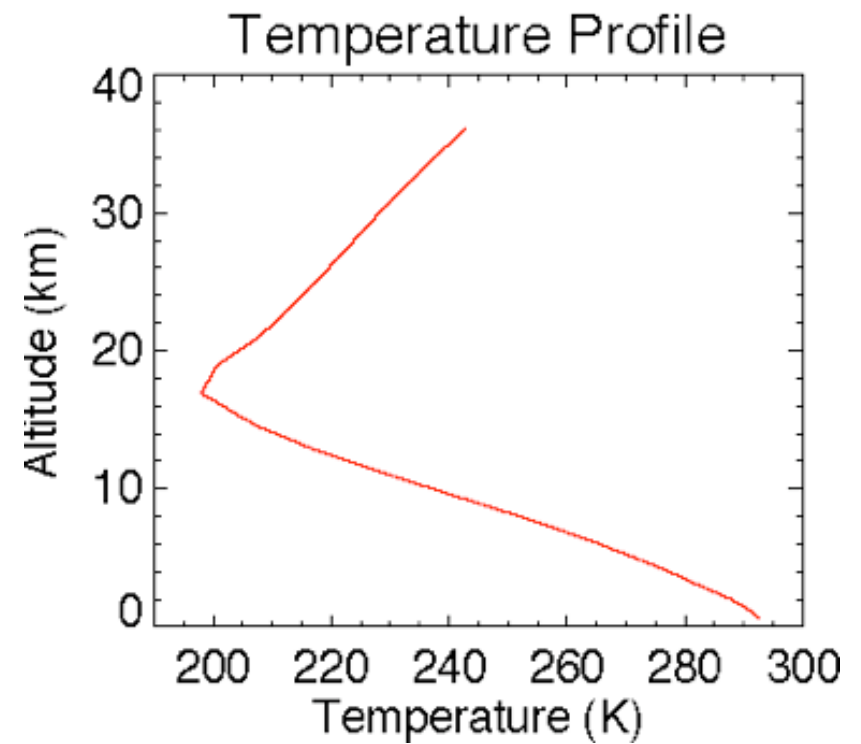
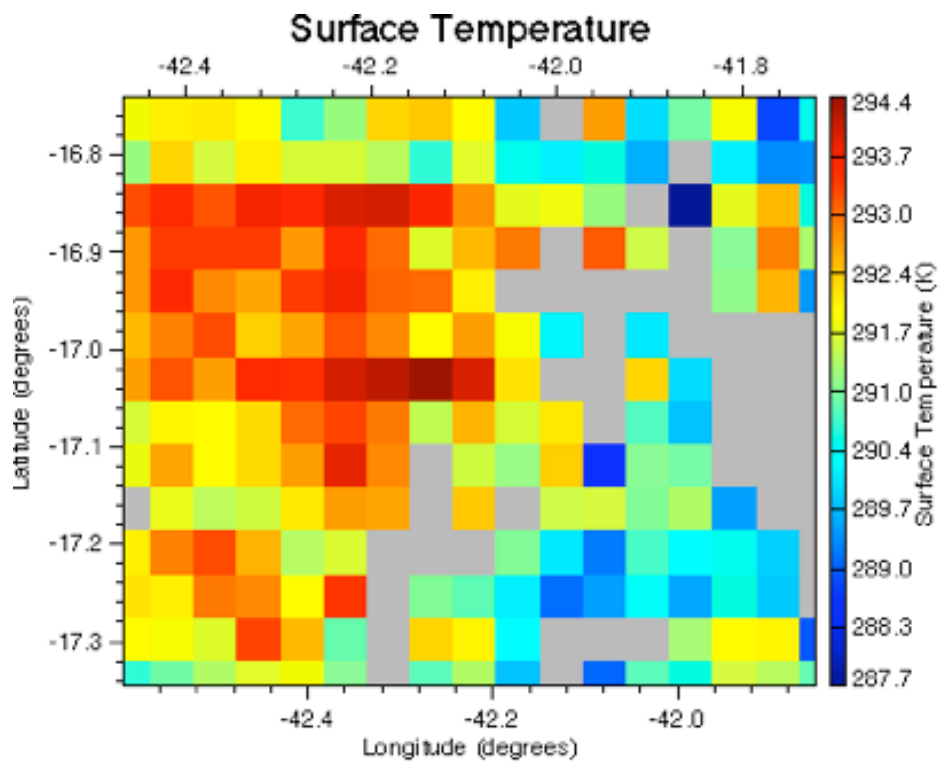
# MODIS Aerosol Products



# MODIS Surface Albedo



# MODIS Temperatures



# **Summary**

- 1. Use MODIS products as inputs to simulate radiative transfer in realistic cloud fields.**
- 2. The output can be compared with observations (MODIS, MISR, CERES).**
- 3. High resolution image from ASTER are useful to understand the simulations.**
- 4. Heating rate profiles useful for understanding of role of solar radiation**